

# **Microelectronic Components Engineering**

## **ENME 808X Fall 2000**

**TTh 3:30-5:00, Room 1108 Martin Hall**

The process of component selection is the heart of the design of electronic systems. This process includes application-independent considerations such as part manufacturer selection, manufacturer quality, part family quality and integrity and distributor quality assessment; and application-specific considerations including: determination of the life cycle environment, reliability assessment, performance assessment, assembly assessment, life cycle mismatch (obsolescence) assessment, legal liabilities, and risk management. This course will cover all the aspects of part selection and management and tie them with the knowledge of electronic component materials, construction and manufacturing. The course will present case studies and involve students in projects and case studies with electronic equipment manufacturing companies.

With ever-decreasing product development cycles, product development teams have to ensure the technical compatibility of the electronic parts that they use with the final products. The decision making process is multi-disciplinary and requires knowledge from areas that are not traditionally taught in the engineering schools. Engineering courses do not prepare the students for the business, legal, cost, warranty, availability issues. Engineers remain at a disadvantage in taking leadership positions in business groups of industry. This course breaks the artificial barriers between classroom teaching and industrial practices and covers both the application and business life cycle of parts. This course will prepare students for leading component engineering teams in industry.

### **Instructors:**

Professor Michael Pecht  
Room 1103 ELB  
Tel: (301) 405-5323  
E-mail: [pecht@eng.umd.edu](mailto:pecht@eng.umd.edu)

Dr. Diganta Das  
Room 1103 ELB  
Tel: (301) 405-7770  
E-mail: [digudas@calce.umd.edu](mailto:digudas@calce.umd.edu)

**Office Hours:** TTh, 2:00 – 3:30 pm. You are welcome to drop by our office anytime. Calling or emailing in advance is suggested. Questions raised due to skipping class(es) should be avoided.

### **Expectations of Students:**

**Attendance:** Sitting-in or auditing this class is not normally permitted. Attending all classes generally leads to good grades.

**Communication Style:** No question is dumb. Ask your questions when they occur to you. Make use of the email addressed of the instructors. Please check the class web site on a regular basis.

### **Grading Process:**

Homework	10%
Project	20%
Mid-term	30%
Final	40%

**Resources:** Class handouts will be made available during each lecture. Relevant paper photocopies will also be provided. Web links to relevant standards and documents will also be provided.

### **Books:**

CALCE Consortium Guidebook of Electronic Parts Selection and Management – copies of relevant chapter and draft sections will be available from the Engineering Copy Center

### **Journals:**

IEEE Transactions on Components and Packaging Technology  
International Journal of Quality and Reliability  
IEEE Magazine of Circuits and Devices

### **Web site:**

<https://www.ajconline.umd.edu/>

All registered students will be given access to the course web site. By default, the glue account login name is the both the login name and password for the class web page. Change your password in the first opportunity.

### **Project:**

The course project is a vehicle for learning how to solve a research problem and contributing to the state of the art in the knowledge of a specific topic. The project work will prepare the students for setting up teams, assigning goals for the team members and the whole group and achieving them within the time and resource constraints. A project topic will be assigned to each group. Each project topic will have a research mentor with whom the group will work closely to develop schedule, identify industrial and academic sources and the final deliverables. You will be graded on both your written report and oral presentations. The project report will need to be of quality for a research journal. All work need to be referenced. Gathering and reporting of latest research results and industrial practices is encouraged.

### **Report Format:**

Word on Windows platform

Single Spaced Times Roman 10 pts

It is highly recommended that you start your projects (research and writing) immediately. It is also recommended that you submit a sample of your report 3 weeks prior to the due date to obtain some feedback on your progress.

Do spell check on everything you write or submit.

All reports need to be submitted in hardcopy and electronic format.

Template for electronic format will be provided and need to be strictly adhered to.

**Homework:** Occasional individual and group homework will be assigned. The homework submissions are expected to be of “industrial” report quality that you would submit to your supervisors.

## Course Outline

- 1 **Motivation for and overview of a parts selection and management process:** It is well understood that the right mix of technology insertion is the key to successful electronic product design, manufacture, and marketing. In electronics, the technology insertion often begins with the selection of the right part. An “eyes-on, hands-off” approach to parts selection and management will be presented.
- 2 **Product requirements, constraints, and candidate part selection:** This session addresses the translation of customer or market requirements into product-level requirements and constraints that are necessary for parts selection. It offers guidance on how to synchronize the technology insertion initiatives of a company with the product-specific design process. Procurement specifications, product analysis, preliminary design, and availability issues will be discussed as part of candidate part selection process.
- 3 **How to read and analyze an electronic part data sheet:** Electronic equipment designers use the part manufacturers’ data sheets to help select parts. To do so efficiently and effectively, designers must understand the data sheet and the limits part manufacturers place on the use of their parts. Although equipment designers are not necessarily bound by those limits, they must be aware of them in order to avoid misinterpretation. This session will introduce the students to the process of reading and interpreting a data sheet.
- 4 **How to assess a candidate part:** This session will introduce the concepts of application-independent and application specific assessment. It will also introduce the composition of the parts selection and management team, sources of information about a part and a manufacturer, and standards about parts selection and management. The concepts of certification and auditing will also be discussed. Quality measures for parts, such as average outgoing quality and process capability indices will be discussed.
- 5 **Part manufacturer, part and distributor assessment:** This topic will be covered in three sessions. In the manufacturer assessment, the part manufacturer’s ability to produce parts with consistent quality will be evaluated, and in the part assessment, the candidate part’s quality and integrity will be gauged. The distributor assessment evaluates the distributor’s ability to provide parts without affecting the initial quality and integrity, and to provide required value-added services. Manufacturer identification, part grouping, and supplier intervention will also be covered.
- 6 **Determination of the local environment:** The local environment of the part affects part design and development decisions, qualification and specification processes, parts selection and management, quality assurance, safety, warranty, support commitments, and regulatory conformance. The local environment is the environment in the immediate vicinity of the part, which often varies from the environment the overall product experiences. This session will cover the basic techniques for determining the local environment for the life cycle of the part.
- 7 **Life cycle mismatch assessment and obsolescence management strategies:** A life cycle mismatch occurs between a product and its constituent parts if parts are not available to support the product throughout its life cycle. An obsolete part can inhibit the functioning of the product, idle the assembly line, lead to dissatisfied customers, and cause a loss of reputation to the company. The life cycle phases of electronic parts will be presented. A mathematical methodology for finding the years to obsolescence for electronic parts will be presented. Several case studies of life cycle mismatch assessment will be presented for different types of electronic parts. Finally, an introduction will be made to different obsolescence management strategies with emphasis of how to select a particular methodology.
- 8 **Performance assessment:** The goal of performance assessment is to evaluate a candidate part’s ability to meet the functional and electrical performance requirements of the product. In cases where the environmental specification of the part is not compatible with the local environment of the part, a method called uprating is used to assess the capability of a part to meet the functionality and performance requirements of the application in which the part is to be used outside the manufacturer’s specifications. Uprating for operating temperatures outside specifications is called thermal uprating. This section will cover the three methods of thermal uprating, namely parameter conformance, parameter re-characterization, and stress balancing.

- 9      **Reliability assessment:** Reliability assessment results provide information about the ability of a part to meet its required performance specifications in its life cycle environment for a specified period of time. This session will briefly cover the methods for reliability assessment of parts.
- 10     **Business and legal issues:** Electronic part selection and management involves getting into contractual agreement with the part supplier and the equipment manufacturer. Once a part is integrated in a system, the equipment manufacturer is responsible for the performance of its equipment irrespective of the sources of the parts. The part manufacturers often put specific limitations on the acceptable use of the parts that the equipment manufacturers may knowingly or unknowingly violate. Several legal and business (e.g., contractual, warranty, patent, liability) issues will be discussed in this session.
- 11     **Tracking part changes:** A part once assessed and integrated into a system does not stay the same. The parts go through updates and changes to meet the technology changes and business goals of the part manufacturer. This session will cover the common changes to parts and the consequent responses from the parts selection and management team. The class will study several actual process change notifications in detail. Die shrink, supply chain fragmentation and internationalization will be covered in this context.
- 12     **Assembly assessment:** A part may be unacceptable from an assembly viewpoint if (1) it is incompatible with the assembly equipment or process; (2) it is impossible or impractical to wire the part into the system (routing compatibility); or (3) it cannot be acceptably tested or reworked. In addition, the issues of part compatibility with the new lead free soldering process will be discussed.
- 13     **Risk management:** After a part is accepted, resources must be applied to manage the life cycle of the part, including supply chain management, obsolescence assessment, manufacturing and assembly feedback, manufacturer warranties management, and field failure and root-cause analysis. It is important to consider the process of managing the part and all the risks associated with the long-term use of the part throughout its life cycle during the parts selection process. The risk management process is characterized by using the risks identified in the parts selection process to determine the resources needed to support a part throughout its application life cycle, thus minimizing the probability of part failure.
- 14     **Economics of part selection and management – return on investment:** Many organizations shy away from instituting a formal parts selection and management process because of their concern with the cost of the program. This session will explain the cost benefit of this program with the help of case studies.